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MECHANICAL AIDS FOR DISTRIBUTION WORK IN DETROIT, MICHIGAN[1]

By W. Montgomery Mitchell[2]

The purpose of this paper is to list and to describe various types of equipment, used in the construction of distributing mains for the Detroit Water Works.

The City of Detroit has gone through a remarkable growth in the last ten years. The United States census of 1910 reported a population of 465,766. The population reported in 1920, for the City proper was 993,739. Adding the suburbs supplied by the Detroit Water Works, the population is brought to a figure considerably over a million. In 1916 a large annexation was voted upon and passed, amounting to an increase of 63 per cent in area. This large annexation called for a large distribution extension.

Prior to 1915 an addition of 40 to 45 miles of water pipe in the distribution system was considered a good year's work. The following is the amount of pipe laid by years, from 1915 to date:

1915	42.14
1916	49.18
1917	70.00
1918	111.50
1919	49.32
1920	130.00

Part of the pipe laid in 1917 and 1918 was laid by contractors. Since then, however, very little pipe has been laid by contractors, except in the outlying villages. On account of the large construction program, which exceeded the program of any other city in this country, in the last 2 or 3 years, it was necessary to make a considerable outlay of money for machinery. I do not believe that any contractor or municipality owns as much equipment for construction work as the Detroit Water Board.

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[1] Presented before the Cleveland Convention, June 9, 1921.

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As the soil in the City of Detroit is principally clay with a little sand, it is ideally suited for the use of trenching machinery.

Materials are stored in three yards. The old central yard is where supplies and materials for all uses in connection with construction, maintenance and operation for the distribution system are kept. The second yard, in the northwest part of the City, is used principally for construction materials and the maintenance and repair of construction machinery. The third yard is in the process of development. This yard may be used principally for pipe, brick, cement, lead and such materials. All yards are adjacent to railroads and are equipped with sidings. They will also be equipped with track scales, storage buildings, etc.

Pipe and heavy materials are unloaded from railroad cars by locomotive cranes. The crane at the main yard is a Browning—15-ton capacity—locomotive crane with a 38-foot boom. Each of the other yards is supplied with an Orton & Steinbrenner, 20-ton capacity, locomotive crane, with 50-foot boom. These cranes easily handle a 48-inch valve or a 48-inch by 48 inch Y-casting, which are about the heaviest pieces handled.

Pipe sizes run from 6 to 48 inches. As a rule a considerable amount of each size is laid each year, with the exception perhaps of 30 and 36 inch.

Pipe and materials are hauled to the site of the job in motor trucks of 3- to 6-ton capacity. The equipment consists principally of Packard trucks, on which the City of Detroit has standardized, in large sizes.

The Detroit Water Board owns 10 trenching machines, 9 of which are driven by gasoline engines. Machines nos. 1 and 2 are of the wheel type trench exacavator, manufactured by the Buckeye Traction Ditcher Company of Findlay, Ohio.

These machines excavate a trench 28 inches wide by 8 feet 6 inches deep, and are used for trenches for pipe up to, and including, 12 inches in diameter. One of these machines was operated for 9 hours continuously last summer, and excavated 2580 feet of trench in that time. The machines are driven by 75 H. P. Automatic 4-cylinder gas engines. All gears are machine cut.

Since May of last year the average cost has been 10½ cents per foot of trench. This includes depreciation, repairs, moving cost, oil and gasoline. Oil and gasoline expense amounts to about 4½ cents per foot.

The wheel type excavator has been found to be an excellent machine for Detroit conditions, the only drawback being the depth which they will dig. I believe this 8-foot 6-inch dimension is the greatest depth for which a wheel type machine has been built. These machines were purchased in 1920 at $10,000 each.

Machine no. 3 is an Austin chain and bucket type trench excavator. It excavates a trench 72 inches by 11 feet 6 inches and is used for 48-inch pipe. The best day's record for this machine is 600 feet of 6-foot trench. It is operated at a cost of $1.40 per foot for a trench 9½ feet deep. It was purchased in 1917 at $9,000, and is still in good condition. It is equipped with a screw hoist for the boom.

Machine no. 4 is an old type Austin with cable hoist for the boom. It excavates a trench up to 36 inches wide, 9 feet deep. It is used principally for 16-inch and 24-inch pipe. It excavated approximately 85,000 feet in 1920 at a cost of 21 cents per foot for a trench 28 inches wide. It is equipped with a 75 H.P. automatic gasoline engine, and consumes about 55 gallons of gasoline per day. The cable hoist has been satisfactory.

This machine can not be crowded through hard ground or through ground which has been slightly frozen, on account of the boom lifting. It depends entirely upon the weight of the boom for excavating. This type of hoist has an advantage, in that the boom will lift over boulders or pipes which may happen to be in its path. The booms on the old Austin machines were of double channel type. This boom is of a box girder type, which is much stiffer and less susceptible to becoming distorted and loose.

Machine no. 5 is an Austin steam chain and bucket excavator, which excavates a trench 6 feet wide by 11½ feet deep. It was purchased in March, 1917, for about $8,500.

Mounted on this machine is a Westinghouse locomotive type vertical air compressor for furnishing air for pneumatic calking hammers with a capacity of 90 cubic feet of free air per minute, and also an air storage tank 24 inches in diameter by 6 feet long. This air compressor takes steam from the boiler for its operations.

We would prefer a vertical boiler for this type of machine and a stiffer frame to stand the vibration due to the surge of the water in the boiler. With steam machines, the water haul is expensive, unless a supply of water is found near where the machine is operated.

Machine no. 6, an Austin 00 type, chain and bucket excavator, excavates a trench up to 42 inches by 8 feet 6 inches. It is equipped with a 75 h. p. automatic engine. It was purchased in 1917, for $8,900. It is too lightly constructed and the vibration loosens the rivets in the frame.

Machine no. 7, Austin 00 type, chain and bucket excavator, is similar to no. 6 but is equipped with oscillating caterpillars. The caterpillars do not have enough bearing, and tend to sink into soft ground and slip. These caterpillars are being rebuilt. The oscillating type is to be preferred over the rigid type, as it saves considerable rack and tear on the machine.

Machine no. 8, Austin chain and bucket trench excavator, has a capacity of 6 feet by 14 feet. It is equipped with a 100 h. p. automatic engine and machine cut gears throughout. The machine is very satisfactory and operates with little vibration. Drive pulleys are placed at the front end of the machine, giving a long drive belt, which we have found to be a very good feature. Water is cooled by an automobile type radiator with fan, which is much more satisfactory than the old type of cooling tank.

Machines nos. 9 and 10 Austin Chain and Bucket type excavators, dig a trench up to 42 inches by 11 feet 6 inches, equipped with machine cut gears and box girder boom. These refinements do not cost much more and increase the life of the machine to a considerable extent.

Machine no. 11, Austin 3½-ton gasoline power crane, is equipped with caterpillar traction and can swing through a full circle. It is used for lowering pipe up to 36 inches into the trench, and has handled a 36-inch gate at a 12 foot radius.

Machine no. 12, a Bucyrus steam crane, has a caterpillar traction —5-ton capacity—and is used for handling 42-inch and 48-inch pipe. It was purchased in September, 1917, for $10,000. It was built for use as a ¾-yard steam shovel. The dipper was removed and the boom equipped with a hook to be used as a crane. The cost of operating this machine amounts to about 75 cents per length of 42-inch and 48-inch pipe.

This crane was purchased with wooden steel shod treads on the caterpillar. For about a year it has been equipped with steel cast treads. Steel cast treads cost about $7.50 each, and none have been broken in a year. The wooden blocks for treads cost $2.00, iron shoe, $5.50, necessary bolts, $1.20, 2 straps, 40 cents, total $9.20. These treads have an average life of about 6 months. This is one of the improvements developed by the Detroit Water Board.

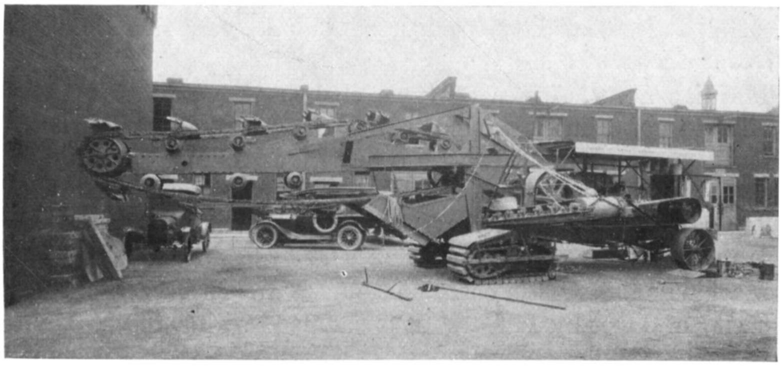

Fig. 1. Austin Excavator

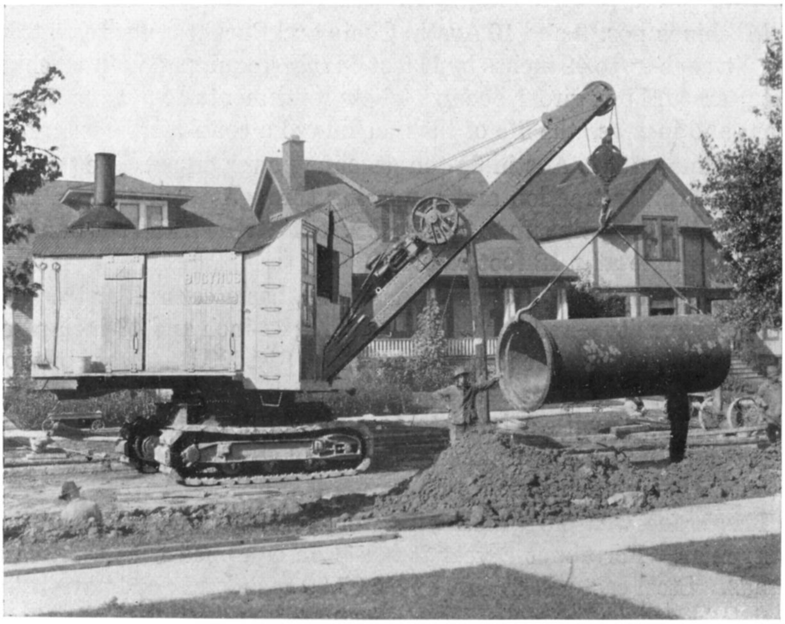

Fig. 2. Bucyrus Steam Crane

This machine, like the steam driven trenching machine, is equipped with 11 inch by 12 inch Westinghouse locomotive type air compressor—capacity 90 cubic feet per minute. As this crane is always near pipe joining operations it does away with the necessity of having a separate air compressor and operator on the job. The only objections to this machine are its excessive weight—39 tons—and its very slow travel.

Machine no. 13, Austin 3½-ton gasoline power crane, is similar to no. 11, but has cast gears and a Buffalo motor. It has a caterpillar traction with treads of pressed steel, which are entirely satisfactory.

For an additional $1,600 we purchased Machine no. 11, which has an automatic motor and machine cut gears, which will have a longer life and a lower maintenance cost.

Machine no. 14, Bucyrus steam crane with 30 foot fabricated boom, costs $9,882, and is likewise equipped with an air compressor. Advantage is taken of all steam driven machinery for supplying compressed air, by mounting an air compressor on the machine, thereby eliminating an additional machine and operator for supplying air.

Machines nos. 17, 18 and 19 are Austin boom backfillers, which were purchased in 1919 at $2,033 each. They are equipped with pressed steel caterpillar treads, 10 h. p. single cylinder Novo engines.

Additional Austin boom backfillers, machines nos. 20, 21, 22, 23 and 24, are the same as no. 19, except that they have 2 cylinder 12 h. p. Novo engines. They cost $2,477 each. These machines have backfilled 1,500 feet per day at 14 cents per foot.

Machines nos. 25 and 26 are Oshkosh backfillers without booms. These backfillers require 2 men to handle the scraper. They are used on hand-dug trenches and are equipped with 6 h. p. Novo engines. These machines have wheel traction and will average about 600 feet per day at 9 cents per foot.

The Austin boom backfillers, machines nos. 27 and 28, have caterpillar traction. They are similar to no. 24, except that they use 2 cylinder, 15 h.p. Novo engines. These machines cost $2,755.

The maintenance on backfillers is much higher in proportion to the original cost than on trenching machines. The machines of greater horsepower are better suited where the spoil bank is partly frozen or is set after long exposure.

The Buckeye concrete breaker, Machine no. 33, is used in breaking concrete foundation under pavements, for opening up trenches. It

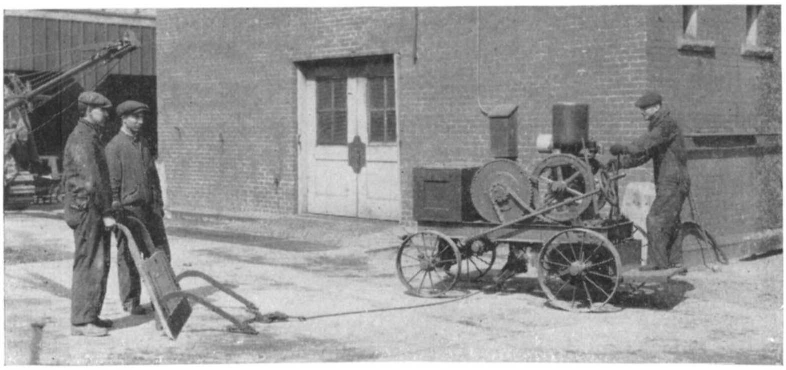

Fig. 3. Oshkosh Backfiller

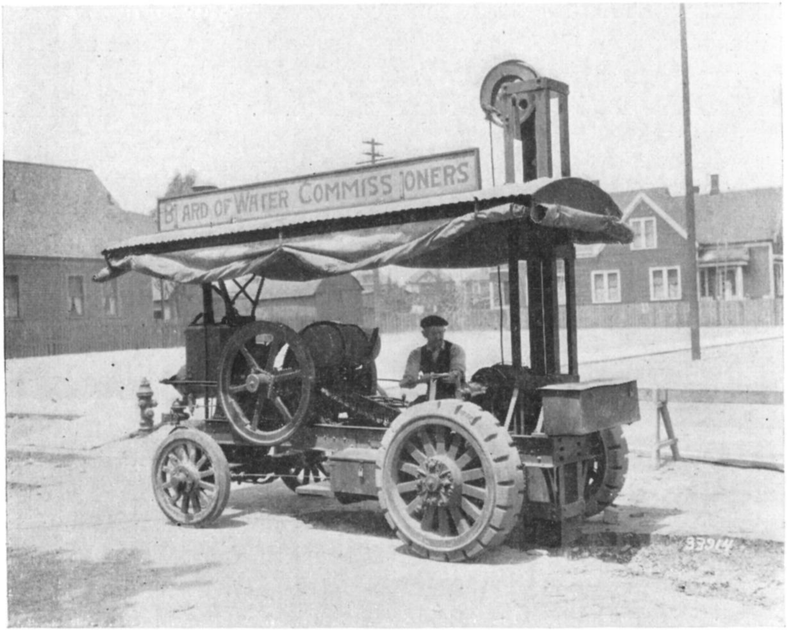

Fig. 4. Buckeye Concrete Breaker

is supplied with a 1,225 pound hammer, 6 foot drop. It is driven by a 14 h.p. horizontal gasoline engine and requires only one man to operate it. It is suitable only for narrow trenches, as wide trenches require more trips over the trench. It is equipped with wheels and rubber tires to relieve machine of some of the shock.

Since the receipt of the last concrete breakers, which will be described presently, this machine is used only for small jobs, as it can be towed about by a motor truck to a job, do the breaking and be moved to another job without delay.

The Buckeye concrete breakers, machines nos. 32, 34 and 35, have oscillating caterpillar traction. This type of machine straddles a 6 foot ditch and is equipped with hammer and leads, which have a cross travel for ditches up to 6 feet, so that concrete over a ditch 6 feet wide may be broken by one trip over the trench. The operation is continuous in that the hammer is raised, by dogs on an endless chain, and automatically dropped from an adjustable height up to 7 feet 6 inches.

As ordinarily operated it strikes 14 blows per minute. The leads and hammer can travel crosswise of the ditch, as the machine is operated so that the result is a series of blows over a trench 6 feet wide.

The leads are equipped with a vertical shaft, carrying 2 gears which engage racks bolted to the frame, so that the leads are always kept in a vertical position.

This machine has broken concrete over a ditch 6 feet wide and 500 feet long in one day. Two men are used—one to operate and the other to oil and watch the operation of the hammer.

Quite a bit of experimenting was done to find the proper wedge point of the hammer. If it is too sharp the wedge point tends to stick, and if too blunt it does not strike an effective blow.

This type of breaker has proven entirely satisfactory and I know of only one machine of a similar type that was built before these were built. The last two received had a few changes on them, namely, the position of the operator's seat, and a stabilizing device for the leads. They use a 14 h.p. horizontal engine, built by the Buckeye Traction Ditcher Company.

Machine no. 36, a Rex Concrete mixer, is run by a 6 h.p. Novo engine. It has a capacity of 7 cubic feet of wet concrete and 10 cubic feet of dry concrete per batch. It has a chain driven drum which operates very satisfactorily. It was purchased in June, 1916, and cost $635. It is used to mix concrete to replace pavements, foundations, sidewalks, piers, etc.

The Koehring Dandy Mixer, machine no. 37, with a 5 h.p. Fuller and Johnson engine, is similar to the Rex machine, except that the drum is gear driven. Our operators claim that one is about as satisfactory as the other.

Machine no. 38, an Austin cube mixer, with $\frac{3}{4}$-yard capacity, was formerly driven by steam engine, which required an engineer and fireman. This machine is now being rebuilt to be driven by a 15 h.p. Novo engine, which will require only 1 man to operate. This machine was purchased in 1912 and is still in good condition. It is used for larger jobs of concreting.

Machine no. 39, Koehring Dandy Mixer, is the same as no. 37, except that no. 37 was purchased in February, 1919, for $545 and no. 39 was purchased in May, 1920, for $1,175.

The Ingersoll-Rand portable air compressor, machine no. 40, is covered and can be completely enclosed when not working. It has sectional radiator for cooling and a 18-inch by 66-inch air tank. The automobile type of motor is easier to keep in repair and a 4 cylinder motor gives less vibration. It is easier to start than the 2 cylinder, heavy horizontal engine, on other types of air compressors. The machine uses about 10 gallons of gasoline per day and is mounted on wheels and can be towed by motor truck.

Machine no. 41, a Chicago pneumatic air compressor, has a two cycle horizontal engine, with a capacity of 133 cubic feet of air per minute, at 375 revolutions. It was purchased in 1916, for approximately $1,800. It is very heavy and hard to move in wet weather. The two cycle is objectionable in that it requires 2 and 3 men to spin it. It is hard to start in cold weather, causing considerable delay.

The Sullivan air compressor, machine no. 42, driven by a 20 h.p. Macy Gas Engine, through a spur gear drive, has a capacity of 97 cubic feet per minute. The gear drive has given considerable trouble and we would not recommend this drive for this purpose, unless it is made of much heavier parts. This machine has the same objection as the engine on the Chicago pneumatic air compressor, although it is more economical in the use of gas, averaging about 17 gallons per day.

The Acme stone crushers, machines nos. 43 and 44, are used for crushing concrete removed from pavements and foundations as it comes from the breaker. The crushed concrete is used as the aggregate in replacing the foundation.

For pumping out wet ditches and cutting mains which can be drained, we have a 3-inch and 4-inch pulsometer and it is our intention to purchase a portable boiler for use in these machines. When possible, they will be used with a steam crane boiler.

For pumping work, requiring pumps of a larger capacity, we have fifteen Parker diaphragm pumps, all driven by Novo engines, 3½ to 4 h.p., four 2 h.p. domestic pumps, and for testing mains, two high pressure testing pumps, driven by 2½ to 3 h.p. Novo engines.

On all of the equipment described above as driven by gas motors, you will notice that a few standards have been adhered to, namely the automatic motor in 75 and 100 h.p. and the Novo engines. This eliminates carrying parts for repairs of various motors, such as would be required for a number of different makes of motors used.

At present we are building a trailer on which will be mounted a 3 kilowatt Delco Farm Lighting outfit. This will be used to light trenches for night work. The trailer will carry the necessary wire and lamps so that such light may be furnished in repairing breaks or other work which must be carried on in night time.

On this same trailer will be mounted a 4½ by 4½ Ingersoll-Rand hopper cooled air compressor—45 cubic feet capacity. This will be sufficient to take care of one hammer for air calking on small jobs, such as repairing a break on a large main. This air compressor will be driven by a 4 cylinder Golden, Belknap & Swartz automobile engine.

On another trailer we are mounting a 6-inch Morris centrifugal sand pump to be driven by the same type of engine.

The maintenance of all of this equipment requires a considerable force of men. We have constructed a building in one of our new yards solely for this purpose. It is 90 feet by 120 feet with a center aisle 30 feet wide, with a Monitor type of roof. The various machine tools and stock rooms are in the side aisles and there is room in the center aisle to dissemble 4 large trenching machines. The machine tool equipment is as follows:

One 500 pound Nazel power hammer—motor driven
One 8 by 6 Bury stationery air compressor
One large size heavy duty milling machine, motor driven—2-B Milwaukee
One 16 inch by 10 foot bed lathe—motor drive
One Kelly heavy duty shaper
One Mueller radial drill
One 16 inch Barnes drill press
One 16 inch Monarch lathe—5 foot bed

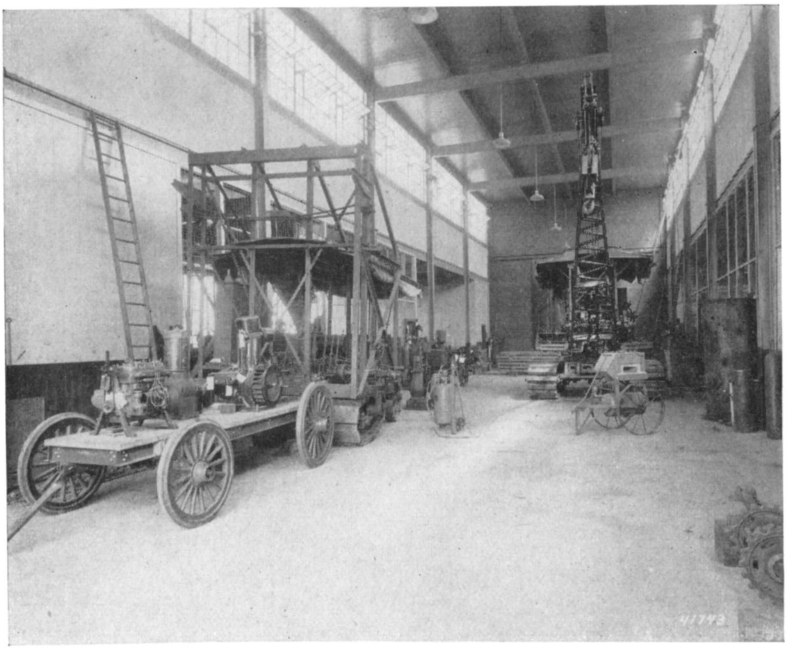

Fig. 5. Interior of Shop

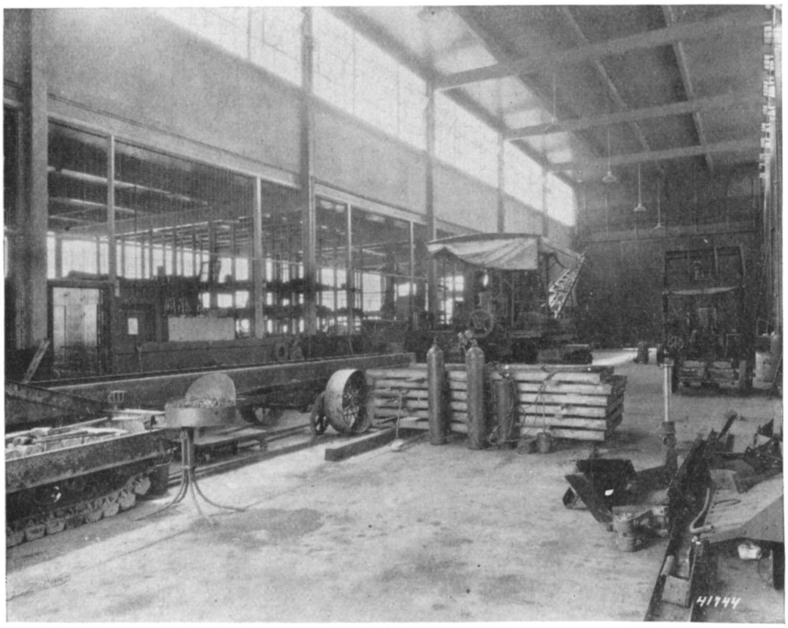

Fig. 6. Interior of Shop

One Newton cold saw—motor drive—this machine will cut up to and including a 15 inch steel channel

One Greenfield grinder for tools. We have found this machine well adapted for grinding cutters for Smith Sleeve and Valve Tapping machines

One 18 inch by 16 inch American lathe, motor driven

In this shop we have a portable oil burning torch for heating various members of machinery, a portable oil furnace for heating rivets, and two portable Prestolite outfits.

The shop is very complete and any part for repairing which is made from standard material, such as, structural steel, shafting, etc., can be cut and finished on these machines, saving delay and expense of ordering same from the manufacturer.

GATE CLOSER

During the winters of 1911 and 1912 a number of breaks occurred in large mains and, as considerable time was consumed shutting off the mains, studies were made for the development of some mechanical device to close the valves.

In 1913 a small Buick truck was provided with a home made device to close gate valves. While this device performed the work in much less time than the manual operation, it was a sort of makeshift. In 1918 studies were started, in conjunction with the Engineering Department of the Packard Motor Car Company, for developing a suitable device to close the large valves. The Packard Company equipped their truck with a power take-off shaft from the transmission case for operating various mechanical devices on the truck.

The device for closing gate valves is mounted on a standard 2-ton Packard chassis. The drive shaft for operating the valves is in a vertical position at the left of the driver's seat, and may be lowered and raised by a hand wheel.

The lower end of this vertical shaft is equipped with a square head. All gate valves in the City of Detroit have an extension stem topped with a square head, which is about 3 inches below the surface of the road. An assortment of double end socket wrenches of various lengths is carried on the machine.

The operation of the valve closer consists of manoeuvring the truck over the road box, which is easily done with the aid of a pointer, and inserting one of these socket wrenches over the extension stem. The drive shaft is then lowered into the other end of the socket wrench and the mechanism started.

Detroit's 48-inch valves require about 220 turns. This formerly took 4 men about 25 minutes. The new machine is ordinarily operated at an average speed of about 25 turns per minute. Care is used to slow up speed when a valve is nearly closed. One man on the machine can do the job, but it takes a little more time.

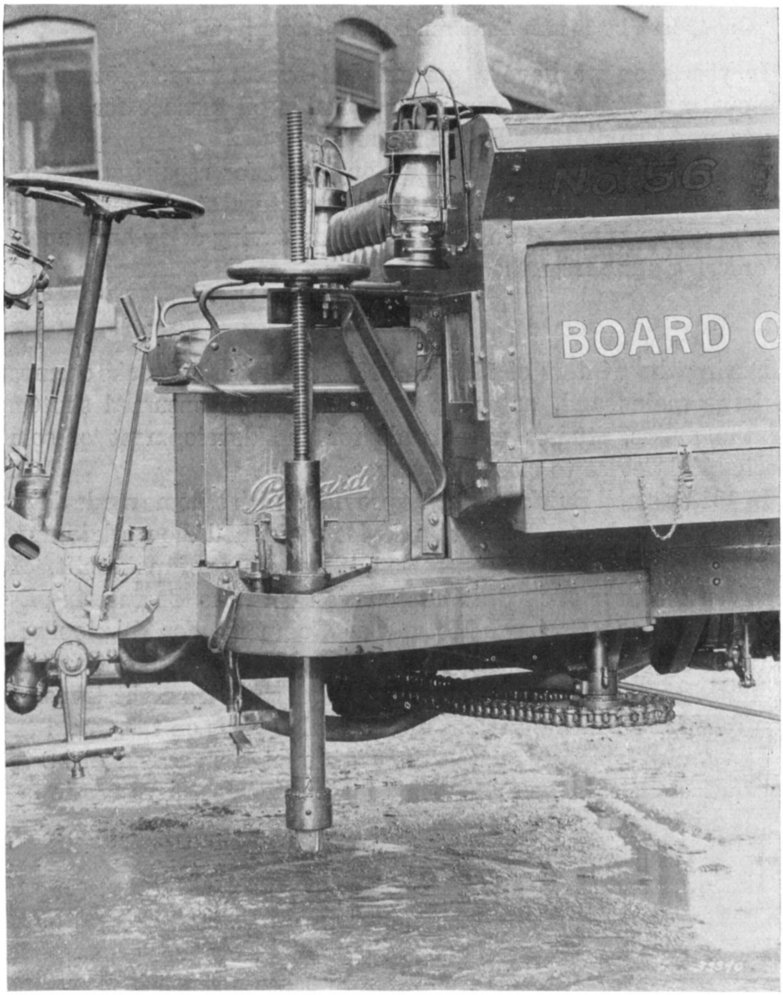

FIG. 7. MECHANICAL DEVICE FOR CLOSING GATE VALVES

The shaft can be reversed for opening valves. It is equipped with a counter which registers the number of turns in either direction and has a set-back to zero.

A spot light is mounted on the left side of the dash, so that it may be turned in a position to illuminate the road box for manoeuvring the machine at night. The ordinary driver can put the shaft over the road box at the first trial.

The body on this truck is built somewhat on the order of a patrol. In place of the seats are boxes which carry maps, valve location books, rubber boots, lanterns, gate keys, oil-skin suits, picks, shovels and other equipment needed for such emergency. On the front end of the box near the operating shaft is a table showing the number of turns for various sizes and makes of gate valves used in Detroit.

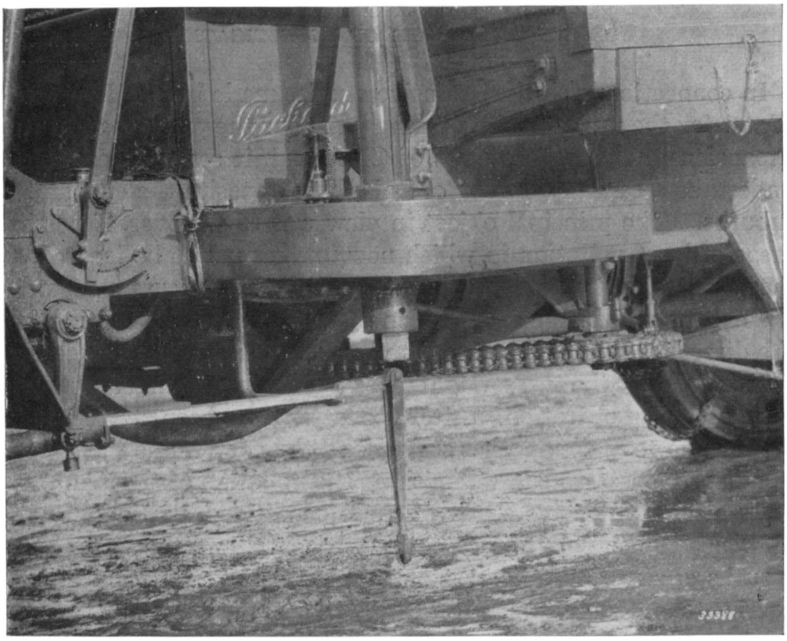

FIG. 8. POINTER FOR CENTERING GATE CLOSER OVER VALVE BOX

A crew of 4 or 5 men is on duty at the central yard for emergency calls. During the night these men are used to wash and oil automobiles when not engaged in emergency work.

The gate closer was purchased in the summer of 1918, completely equipped, except for construction tools, for $5,332. A second one was bought last summer for $5,314. One is now used to shut off all mains of 24-inch size and over.